the fluids from the leaves of woody as compared with those from herbaceous plants, and (2) that the sap concentration shows a variation corresponding to the xerophytism of the plant community from which the fluids are obtained.

The importance of the latter relationship has been given emphasis in a paper which gives a summary of results concerning large and widely differing plant formations.[31] Here it is seen that the concentration of the cell sap of the woody plants varies from 11.44 atmospheres for that from the rain forest and 14.4 for that from mesophytic habitats to 24.97–30.05 atmospheres for the fluids of desert plants. Herbaceous plants from these same habitats show sap concentration values of 8.80, 10.41, and 15.15 atmospheres respectively. As might be expected, succulent halophytes show even higher concentrations, culminating, perhaps, in 49.7 atmospheres for *Batis maritima*. Curiously enough, the epiphytes of the rain forest show concentrations of a low order, such as 3.34–4.88 atmospheres for the epiphytic Orchidaceae from Jamaica and Florida.

These and other similar results are sufficient to demonstrate that in this line of investigation there has been found a means of expressing in a quantitative manner the sap properties of both large and small plant communities; hence not only must the results themselves be regarded as important, but a much higher value must be placed upon the introduction of a method which will tend to exactness in studies of the physiological plant geography.—GEO. D. FULLER.

Natal vegetation.—In advancing our acquaintance with the vegetation of South Africa, BEWS[32] has made a study of the species native to Natal according to RAUNKIAER'S life-forms, and has expressed the results in a biological spectrum for that part of South Africa. Some of the conspicuous features of the vegetation as shown by this analysis are the richness, manifest in more than 3000 species, and the small number of large phanerophytes which is far below the average in contrast with the abundance of lianas, chamaephytes, and geophytes. One of the interesting incidental features of the vegetation consists in the presence of stem succulents, all possessing a milky juice, as they belong to the *Asclepiadaceae* and *Euphorbiaceae*.

In a more recent paper, the same writer[33] has described the vegetation of the mountains forming the western boundary of Natal and reaching an altitude of 3400 m. The outline of the plant communities involved shows that grassland and scrub associations predominate. Of the latter, the one developed

[31] HARRIS, J. ARTHUR, Physical chemistry in the service of phytogeography. Science N.S. **46**:25–30. 1917.

[32] BEWS, J. W., The growth forms of Natal plants. Trans. Roy. Soc. S. Africa **5**:605–636. 1916.

[33] ———, The plant ecology of the Drakensberg range. Annals Natal Museum **3**:511–565. 1917.

upon many of the steep slopes is termed "Fynbosch" and described as a sclerophyllous formation comparable to the chaparral of the United States. It is dominated by shrubs with needle and ericoid leaves, conspicuous among which are the genera *Cliffortia* (Rosaceae) and *Erica*, both represented by several species, and a large number of woody Compositae. In its undergrowth, bulbous plants abound. From it BEWS traces a double succession, one to the "bush" or forest, in which *Podocarpus* spp. and *Celtis Kraussiana* are the most abundant trees, the other to the mountain veld. The former is clearly leading to the climax type of tree vegetation developing only under the most favorable conditions of soil and exposure; but the succession in the latter instance does not seem clear, for the veld is apparently more xerophytic, although more extensive than the "Fynbosch."—GEO. D. FULLER.

Germination of tree seeds.—BOERKER[34] has carried on three series of greenhouse cultures to determine the effect of light, soil moisture, and soil texture upon the germination of the seeds of various forest trees. The cultures were extensive and the environmental factors rather carefully controlled. The variations in response are too numerous to be touched upon in a review, but some items of the summary show that it has not been possible to isolate the effect of single factors, as it is stated that shade accelerates germination and this acceleration is due to increase in soil moisture caused by decreased evaporation and transpiration. On the other hand, light is found to play absolutely no part in the germination of tree seeds. Similarly, the differentiation between the effects of soil moisture and soil texture has not been accomplished.

The reaction of different tree species to the different sets of conditions is interesting, and the results should be of practical service to foresters. The increase of length of tap and lateral roots in *Pinus ponderosa* with diminishing soil moisture content may be cited as one of the results. *P. ponderosa* growing in the Rocky Mountains produces smaller seeds that germinate more quickly than those from the same species grown upon the Pacific coast. Similar differences were found for local varieties of *Pseudotsuga taxifolia;* while in both species large seeds proved superior to small, both in higher germination percentage and in the size of the seedlings.—GEO. D. FULLER.

Law of the minimum.—HOOKER[35] gives an interesting discussion on the application of the law of the minimum, or limiting factors, to biological problems. He is perhaps fortunate, in so far as rigid application of the law is concerned, in drawing his early illustrations from simple chemical and physical processes, for it is rapidly becoming a question whether the law applies to plant

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[34] BOERKER, R. H., Ecological investigations upon the germination and early growth of forest trees. 8vo. pp. 89. *pls. 5*. Thesis Univ. Nebraska. 1916.

[35] HOOKER, D. H., Liebig's law of the minimum in relation to general biological problems. Science N.S. **46**:197–204. 1917.